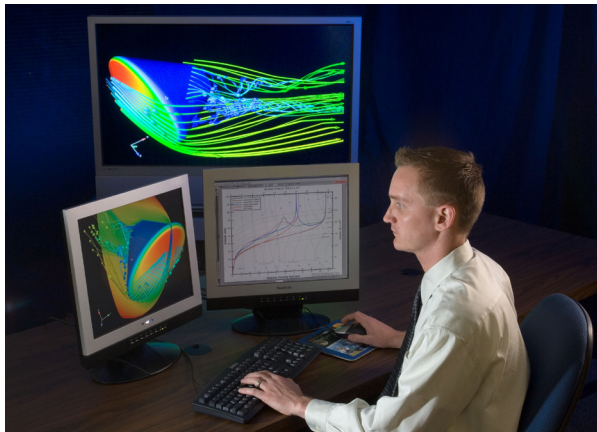


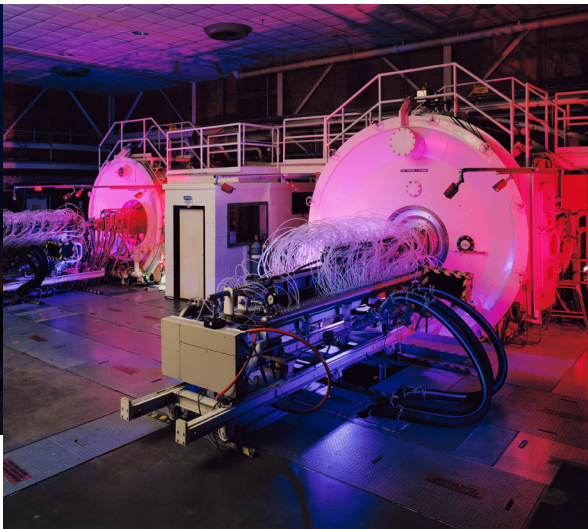
Entry, Descent, and Landing

Energy dissipation in a short amount of time, high entry velocities, composition of the atmosphere, and hitting the target encompass the challenges of planning for entry, descent, and landing. Johnson Space Center (JSC) provides a combination of ground test, analytical, and flight test capabilities needed to develop entry, descent, and landing systems.



Services Provided

- Earth (air test gas), Mars, and Venus planetary entry testing (carbon dioxide test gas)
- Thermal protection systems materials testing and screening
- Simulation of
 - Ascent heating and pressure decay
 - Reentry heating and pressure
- Computational resources to assist in studies of fluid dynamics, aerodynamics, and aerothermodynamics
 - Aerodynamic performance and loads
 - Aerothermal environments
 - Computational Fluid Dynamics (CFD)
- Flight phase development and performance
 - Departure and arrival windows
 - Attitude pointing analysis
 - Parachute/parafoil dynamics and performance assessments
- Real-time simulation of closed-loop lander systems
- Design limit load, integrated launch abort, and drop testing of parachute systems



Atmospheric Reentry Materials and Structures and Radiant Heat Test Facilities

JSC offers expertise and facilities for the simulation and testing of the aerothermal heating experienced by spacecraft as they enter planetary atmospheres. The 13 Megawatt Arc Tunnel provides capability to perform aerothermal heating environment tests necessary for the screening, development, and certification of manned and unmanned spacecraft thermal protection systems. The Radiant Heating Test Facility provides capability of performing multizone, high-temperature, radiant heat testing of large spacecraft thermal protection systems and associated structures in a controlled pressure environment to simulate reentry thermal profiles, thermal gradient, and pressure.

Facility	Article Size	Gas	Pressure Range	Temperature Range (°F)
Conical nozzle	27" Dia	$N_2 + O_2$ (0 – 50% O_2), CO_2	2 – 1000 psf	400 °F – 5,500 °F*
Channel nozzle	24" x 24"		4 – 110 psf	1,000 °F – 3,100 °F*
Radiant heat – 1	72" x 110"	Air, N_2	4 – 110 psf	-300 °F – 3200 °F
Radiant heat – 2	24" x 24"			-300 °F – 3200 °F

Aeroscience and Computational Fluid Dynamics Laboratory (AeroLab)

The AeroLab provides computational resources to assist in studies of fluid dynamics, aerodynamics, and aerothermodynamics. Much of the work in the laboratory involves interactive computer graphics and includes Computer Aided Design (CAD) model generation, CFD grid generation, and flowfield visualization. In addition, the computers are configured to provide a parallel computing environment for large-scale simulations. These include Direct Simulation Monte Carlo analyses of low density flows as well as some CFD computations.

Flight Mechanics Laboratory

The laboratory uses a high-performance Linux computing cluster along with many specially designed software tools in order to solve various flight mechanical disciplines, including

- Performance optimization
- Preliminary guidance design
- Launch and landing opportunities
- Preliminary control system design
- Aerodynamic stability
- Parachute deploy through landing dynamics
- Entry trajectory design
- Hazard avoidance

Yuma Proving Ground

JSC has access to a remote facility at the United States Army Yuma Proving Ground for air delivery testing of parachute systems. The facility provides capability to perform design limit load, integrated launch abort, and drop testing of parachute systems.

Hardware-in-the-Loop ALHAT System Testbed (HAST)

The laboratory integrates software models of vehicle dynamics and systems with hardware models (e.g., sensors) to provide real-time simulation of closed-loop lander systems supporting Autonomous Landing and Hazard Avoidance Technology (ALHAT).

We have developed customer-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise with new customers. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.



For the benefit of all

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